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PATENT
03466-P0001B WWW/SBS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re The Application Of

Hans-Wulf Pfeiffer

Serial No.: 09/929,267

Filed: August 14, 2001

For: Method Of Increasing The Boundary Layer Strength On Surfaces Of Workpieces Made Of Brittle Hard Materials

Examiner: John Hoffmann

Group Art Unit: 1731

Appeal Brief Under 37 C.F.R. §1.192

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Having filed herewith a Notice of Appeal from the final rejection of claims 1 – 18, all of the claims currently pending, the final rejection being mailed on March 29, 2005, Appellant submits its Appeal Brief for the above-captioned application pursuant to 37 C.F.R. §1.192 in triplicate as follows.

Certificate of Mailing: I hereby certify that this correspondence is today being deposited with the U.S. Postal Service as first class mail in an envelope addressed to: : Mail Stop Appeal Brief – Patents; Commissioner for Patents; P.O. Box 1450; Alexandria, VA 22313-1450.

June 29, 2005

Charlotte E. Hanulik

Charlotte E. Hanulik

Real Party in Interest

The real party in interest is Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung residing at Hansastrasse 27c; D-80686 Muenchen, Germany.

Related Appeals and Interferences

There are no related appeals or interferences.

Status Of Claims

Claims 1 – 18 are currently pending, stand rejected and are the subject of the instant Appeal. A copy of each of these claims is attached hereto as Exhibit A.

Status Of Amendments

Subsequent to the Non-Final Rejection being mailed on October 28, 2004, Appellant filed a Response to the Non-Final Official Action on February 18, 2005. A Final Rejection was mailed on March 29, 2005 to which this Appeal is directed. Applicant did not file a Response to the Final Official Action.

Summary Of Invention

As described in the specification, Appellant discloses and claims a method for increasing the boundary layer strength of a ceramic workpiece. The method comprises the steps of providing a workpiece consisting of ceramic, the temperature of the workpiece not being elevated above room temperature and which does not comprise zirconia. The method further comprises the steps of providing a tool having at least a partially rounded contour with a predetermined diameter, the tool having at least the same order of hardness as the ceramic workpiece. The method still further the steps of contacting the ceramic workpiece

with the tool within a predetermined surface area, the predetermined surface area being less than the total surface area of the ceramic workpiece and selected based upon the composition of the workpiece. The method also includes the steps of producing a plastic deformation on the predetermined surface area, and generating internal compressive strain within the ceramic workpiece in the vicinity of the predetermined surface area. The tool is provided such that the diameter of the tool does not exceed a critical value ranging from about .1 mm to about 4 mm, the critical value depending upon the composition of the ceramic workpiece. The method allows for damage in the form of brittle fracture processes in the predetermined surface area to be substantially avoided and the boundary layer strength of the ceramic workpiece is increased even though the temperature of the workpiece is not elevated above room temperature.

References Cited And Applied

U.S. Patent No. 5,128,083 to Brookes.

U.S. Patent No. 3,573,023 to Thomas et al.

U.S. Patent No. 6,153,023 to Rokutanda et al.

Abstract of JP 04108675.

U.S. Patent No. 5,228,245 to Rice et al.

Grounds Of Rejection

Claims 1 – 18 stand rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement. Claims 1 – 18 stand rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 5,128,083 to Brookes ("Brookes") in view of U.S. Patent No. 3,573,023 to Thomas et al.

("Thomas"), further in view of U.S. Patent No. 6,153,023 to Rokutanda et al. ("Rokutanda"), and further in view of the Abstract of JP 04108675 ("JP Abstract"). Claims 1 – 18 further stand rejected under 35 U.S.C. §103 as being unpatentable over Brookes, Thomas, or JP Abstract in view of U.S. Patent No. 5,228,245 to Rice et al. ("Rice").

Issues Presented For Review

(1) Whether the claims contain subject matter which is not described in the specification in such a way as to enable one skilled in the art to which it pertains, to make and/or use the invention.

(2) Whether the four prior art references teach each and every claim limitation required by the claims.

(3) Whether further modification of four prior art references accordingly to the present claims would be obvious.

(4) Whether the four prior art references may properly be combined when such combination is taught away from by at least some of the references, and when the teachings of some of the references are repugnant to the teachings of others of the references.

Grouping of Claims

The claims do not stand or fall together. The invention is claimed from several perspectives, each defining the invention in materially different terms.

Each of the independent claims defines the invention from a unique perspective and are materially different in scope. Each independent claim requires a combination of material elements which differs from the combination

of material elements required by each of the other independent claims. Each of the dependent claims adds specific additional elements to the novel combination of the independent claims. As such, all claims must be considered because it is improper to fail to consider any limitation in the claims. *In re Geerdes*, 491 F.2d 1260, 1262, 180 U.S.P.Q. 789, the 791 (CCPA 1974) ("every limitation in the claim must be given effect rather than considering one in isolation from the others").

Argument

35 U.S.C. §112, first paragraph Rejection

The Examiner discussed eight factors in determining whether there is sufficient evidence to support a determination that the disclosure does not satisfy the enablement requirement including:

(A) the breadth of the claims;
(B) the nature of the invention;
(C) the state of the prior art;
(D) the level of one of ordinary skill;
(E) the level of predictability in the art;
(F) the amount of direction provided by the inventor;
(G) the existence of working examples; and
(H) the quantity of experimentation needed to make or use the invention based on the content of the disclosure.

(A) All the claims of the present invention are limited to a workpiece consisting of ceramic. The Examiner however has stated that even though the claims require a workpiece consisting of ceramic that the claims also cover workpieces comprising "ceramets, carbon compsites, etc." (Official Action 3/29/05, p. 3). The Examiner has further submitted that he "does not agree with applicant's position that the claims are limited to "true ceramics" (whatever that

would mean)." *Id*. The Examiner has still further submitted that because the claims are presented as a method "comprising the steps of" format, that the claims are open to additional steps, which could include the step of "adding a non-ceramic feature thereto, then providing a tool, etc." (Official Action 3/29/05, p. 5). Appellant respectfully disagrees.

Appellant respectfully submits that the claims are limited to workpieces made solely of ceramic (such as silicon nitrides) and do not cover various composite materials as suggested by the Examiner, such as cermets or cemented carbides. *See e.g.* Specification paragraphs 4, 25, and 31. While Claims 1 and 10 both require the limitation of providing a "workpiece consisting of ceramic", the Examiner has ignored the further limitations of Claims 1 and 10, which also require "providing a tool which has . . . the same order of hardness as the ceramic workpiece", "contacting the ceramic workpiece with the tool", "generating internal compressive strain within the ceramic workpiece", and "wherein . . . upon contacting the ceramic workpiece with the tool, generation of damage in the form of brittle fracture processes in the predetermined surface area is substantially avoided and the boundary layer strength of the ceramic workpiece is increased." (emphasis added) All of these steps require use of a ceramic workpiece, which is claimed as a "workpiece consisting of ceramic." There is no opportunity to insert a non-ceramic material insertion step as suggested by the Examiner.

The Examiner has further submitted that he does not know what a "true ceramic" is. (Official Action 3/29/05, p. 3). Appellant respectfully submits that

the terms "true ceramics" and "near ceramics" are terms used and understood by those of skill in the art. For example, these terms are used in Thomas where, in differentiating "ceramics" from "near ceramics" Thomas teaches that "we suggest these – materials comprising tungsten carbide, boron carbide, aluminum oxide, or magnesium oxide – to encompass both the near ceramics and the true ceramics." (col. 3, lines 52-55). Thomas further teaches that "the type of material undertaken for treatment will dictate use of either the basic method of our invention, or the temperature-controlled method of our invention. For the mechanical deformation of materials comprising tungsten carbide can be carried out at normal room temperatures. Materials comprising aluminum oxide, however, require surface deformation in an elevated-temperature environment." (col. 3, lines 58-65). Further clarifying the difference between near ceramics and true ceramics, Thomas itemizes workpieces as follows: "cemented carbides, e.g., tungsten carbide, or boron carbide", and true ceramics "those comprising aluminum oxides, or magnesium oxides."(col. 1, lines 43-45). Appellant therefore respectfully submits that despite the fact that the Examiner does not know what true ceramics are, this term is used by and is well known in industry by those of skill in the art as evidenced the clear usage in Thomas.

Appellant still further notes that as stated in Appellant's declaration, the term "ceramic" "does not include non or near ceramic materials compositions such as for instance, cermets and cemented carbides" (Attached as Exhibit B, Declaration of Mr. Hans Wulf Pfeiffer dated 3/9/04) as suggested by the Examiner. The Examiner arguments appear to ignore the common usage of

terms used in industry and simply dismisses Appellant's Declaration as to the breadth of the term "ceramic." However, Appellant respectfully submits that the term ceramic has been clearly defined to exclude "ceramets, carbon compsites, etc." as suggested by the Examiner.

(B) The Examiner has stated that the nature of the invention does not lend itself as evidence to show the invention is enabled. (Official Action 3/29/05, p. 3). Appellant notes that the detailed description discloses specifics relating to the method as claimed including the results from experimentation including for example: par. 25, "an increase of the boundary layer strength of 15% could be achieved"; par. 27, "plastic deformation is restricted to a predetermined laterally narrowly limited surface area"; par. 27, "the tool . . . must be rated as non-sharp-edged"; par. 29, "critical values for the sphere diameter range from about .1 mm to a maximum of 4 mm"; par. 31, "For determining process parameters required for successful operation preferably two preliminary experiments must be performed: on a plate of the material to be treated the dependence of the compression yielding point and brittle fracture limit on the tool geometry is determined. To this end the static ball thrust test is employed, for instance, which is described e.g. in the article by T. hollstein et al. "Vollkeramische Baelzlager aus Siliziumnitrit: Anwendun, Auslegung und Optimierung" [Fully ceramic rolling bearings made of silicon nitrite: application, designing and optimization], in: VDI-Reports no. 1151, 1995, pages 3 to 10." ("the static ball thrust article"); par. 31, "A material having at least the same hardness as the workpiece to be treated is selected as tool material" and that the "preliminary

experiment furnishes the required tool geometry and the admissible amount of momentum to be introduced."

Accordingly, Appellant respectfully submits that all steps and requirements as claims are described so as to show the invention is enabled.

(C) The Examiner has submitted that the state of the art is that applicant's invention cannot be done. Appellant agrees with the Examiner that the prior art, including that cited by the Examiner against the present claims, has failed to achieve the desired result of increasing the boundary layer strength of workpieces made solely of ceramic without first increasing the temperature of the workpiece substantially above room temperature. Applicant notes however, that the fact that others have not been able to solve this long standing and vexing problem in the industry is not evidence that Appellant's method disclosed and taught in the specification does not achieve the results described therein. Rather, as stated in the specification "[i]t was possible, for instance, to demonstrate that a workpiece made of silicon nitrite could be processed by plastic deformation on its surface with application of shot-peening methods in such a way that an increase of the boundary layer strength of 15% could be achieved." (par. 25). Appellant has specifically stated the beneficial results that may be obtained in following the steps outlined in the specification. The Examiner appears to simply ignore these results or may simply not believe the submission in the specification. Either case is not evidence that the claimed process will not achieved the specific results taught in the specification.

(F) The Examiner has submitted that the "amount of direction provided by the inventor is low" and that there "is no indication or suggestion as to what ceramics might work or what amount of force is needed to get the strengthening effect." (Official Action 3/29/05 p. 4). Appellant again respectfully disagrees. As stated above in sections (A) and (B), the material of the workpiece is limited to a ceramic and does not include composite materials such as cermets and cemented carbides. In addition, the specification teaches that a "static ball thrust test" is to be employed, referencing the article by T. hollstein et al. "Vollkeramische Baelzlager aus Siliziumnitrit: Anwendun, Auslegung und Optimierung" [Fully ceramic rolling bearings made of silicon nitrite: application, designing and optimization], in: VDI-Reports no. 1151, 1995, pages 3 to 10, which is incorporated by reference, which fully outlines and details for performing a "static ball thrust test." The specification further details how the static ball thrust test is to be performed to achieve the desired strengthening results as previously referenced above.

(H) The Examiner has further submitted that the "prior art indicates the invention would not work." (See response to (C) above).

Appellant respectfully submits that static ball thrust tests as taught in the static ball thrust article from 1995 are well known in the art, however, the novel combination of the specific steps taught in the specification provide the "unforseen finding that an increase of the boundary layer strength by mechanical treatment on the surface is possible on brittle, hard materials, without the necessity of elevating the temperature of the brittle, hard material." (par. 25).

Accordingly, Appellant respectfully submits that the specification does enable one of ordinary skill in the art to practice and achieve the results disclosed in the specification without undue experimentation.

35 U.S.C. §103 (a) Rejections

All the claims of the present application require, among other steps, providing a workpiece consisting of ceramic, the temperature of which is not elevated above room temperature and which does not comprise zirconia, providing a tool having a diameter that does not exceed a range from about .1 mm to about 4 mm and is at least the same order of hardness as the ceramic workpiece, contacting the ceramic workpiece with the tool within a predetermined surface area, generating internal compressive strain within the ceramic workpiece in the vicinity of the predetermined surface area where generation of damage in the form of brittle fracture processes in the predetermined surface area is substantially avoided and the boundary layer strength of the ceramic workpiece is increased.

The Examiner has submitted that the "language that the workpiece is "consisting of ceramic . . . is met because the relevant references disclose that the item is a ceramic material." (Official Action 3/29/05 p. 5). Appellant admits that Thomas teaches use of true ceramics, however, Thomas fails to teach impacting a true ceramic without first elevating the temperature of the ceramic workpiece. Thomas specifically teaches that "the type of material undertaken for treatment will dictate use of either the basic method [non-temperature elevated] of our invention, or the temperature-controlled method [elevated temperature] of

our invention. For the mechanical deformation of materials comprising tungsten carbide [cermets] can be carried out at normal room temperatures. Materials comprising aluminum oxide [ceramics], however, require surface deformation in an elevated-temperature environment." (col. 3, lines 58-65)(emphasis added). Therefore, Appellant agrees with the Examiner that Thomas teaches use of ceramics, however, Thomas specifically teaches that ceramics (i.e. aluminum oxide) must be elevated in temperature prior to treatment.

In differentiating "ceramics" from "near ceramics" Thomas teaches that "we suggest these – materials comprising tungsten carbide, boron carbide, aluminum oxide, or magnesium oxide – to encompass both the near ceramics and the true ceramics." (col. 3, lines 52-55). Thomas further differentiates ceramics from cermets and cemented carbides where it itemizes work pieces comprising "cemented carbides, e.g., tungsten carbide, or boron carbide", and ceramics including "those comprising aluminum oxides, or magnesium oxides." (col. 1, lines 43-45). Therefore, Thomas teaches that the true ceramics (i.e. aluminum oxide, magnesium oxide, etc.) require treatment at an elevated temperature, while the near ceramics also called the cemented carbides (i.e. tungsten carbide, boron carbide) may be treated at room temperature.

With regard to Brookes, Appellant respectfully submits that the specification describes some general principles of the process stating that "[i]t has been found that the principle variables which have to be controlled during treatment of a hard engineering ceramics material in accordance with the process of the present invention to achieve the benefits ascribed above are as

follows: ... 2. The temperature at which the process is carried out must be less than that at which adhesion and seizure would occur between the surface of the hard engineering ceramics material being treated and the second material applying the point/line loading through processes of bulk diffusion yet high enough to enable significant dislocation mobility. This will usually be in the range of 0.3 Tm to 0.5 Tm", where the bottom end (0.3 Tm) is approximately 420°C. (Col. 2, lines 16-20 and 26-33) (emphasis added). Further reading of Brookes points out that certain "principle variables . . . have to be controlled" and that while the temperature may vary, the range is 420°C to 700°C. (emphasis added). Therefore, Brookes also teaches that ceramics must be elevated significantly in temperature prior to mechanical deformation.

Appellant further submits that Rokutanda is not directed toward hardening of ceramic workpieces, but rather teaches a method for "projecting shot on the hardened surface of the hard metal product." (Abstract). Likewise, the JP Abstract is entitled "Ceramic-Metal Joined Structure" and is described as a "joined structure of a ceramic component and a metal component." (JP translation provided by Examiner, at p.3). The JP translation further states that "[s]ince the ceramics are inherently brittle materials, however, it is difficult to use them alone, and it is more rational to rely on a method wherein a ceramic is used only in a site that must meet a performance requirement base on its combination with another material." (JP translation, p. 4). Appellant therefore respectfully submits that neither Rokutanda nor the JP Abstract teach or suggest impacting a ceramic which

is not elevated above room temperature as one is directed to a metal and the latter to a cermet.

Based on the foregoing, because none of the above-listed prior art teaches, discloses, or suggests, providing a workpiece consisting of ceramic, the temperature of which is not elevated above room temperature and which does not comprise zirconia, providing a tool having a diameter that does not exceed a range from about .1 mm to about 4 mm and is at least the same order of hardness as the ceramic workpiece, contacting the ceramic workpiece with the tool within a predetermined surface area, generating internal compressive strain within the ceramic workpiece in the vicinity of the predetermined surface area where generation of damage in the form of brittle fracture processes in the predetermined surface area is substantially avoided and the boundary layer strength of the ceramic workpiece is increased, as required by the claims, none of the cited references can render any of the claims obvious.

Appellant further respectfully submits that it would not be obvious to further modify Brookes, Thomas, Rokutanda or the JP Abstract to include the limitation of not elevating the ceramic workpiece above room temperature because at least both Brookes and Thomas specifically teach otherwise, while neither Rokutanda nor JP Abstract comment on the use of true ceramics.

With respect to Rice the specification teaches "[t]ransformation toughening of ceramics is most well known in bodies containing metastable tetragonal zirconia particles" and goes on to teach a method for hardening a ceramic comprising "partially stabilized zirconia (PSZ)" (Col. 1, lines 13-15 & 30-

31), or "tetragonal zirconia ... referred to a 'TZP'" (Col. 1, lines 35 and 38-39), or "zirconia-toughened alumina (ZTA)." (Col. 1, lines 44-45.) Additionally, all of the examples listed in the specification of toughening a workpiece include use of zirconia (*See e.g.* Col. 3, lines 39-46 and 62-64; Col. 4 lines 3-7 and 16-17). Accordingly, Appellant respectfully submits that the method taught in Rice includes zirconia in each case and will not work for ceramics at room temperature unless they contain zirconia. Therefore, Rice fails to teach impacting a ceramic that does not comprise zirconia which is not elevated above room temperature as required by all of the pending claims.

Appellant further respectfully submits that it would not be obvious to further modify Brookes, Thomas, the JP Abstract or Rice to include the limitation of not elevating the ceramic workpiece above room temperature because at least both Brookes and Thomas specifically teach otherwise, the JP Abstract teaches use of a ceramic-metal joined structure rather than only a true ceramic, and Rice specifically teaches that zirconia must be used with ceramic.

Moreover, Appellant respectfully submits that the above-listed references are not properly combined in order to formulate an obviousness rejection. There is no suggestion to combine the cited prior art and in fact, the references themselves teach away from combination.

For example, The claims require that the ceramic not comprise zirconia, however, Rice only teaches methods that use zirconia. It cannot be obvious to combine this reference then as the Examiner has suggested. In addition, Rokutanda is directed toward a method of hardening metal, not ceramic, which has

fundamentally different characteristics and difficulties. There is no suggestion in either reference to combine them with Brookes or Thomas.

Conclusion

Appellant has made a significant advance over the prior art by providing a method for increasing the boundary strength of true ceramics, which may be performed at room temperature, the ceramics not comprising zirconia, that was previously not possible. Accordingly, reconsideration and allowance of all pending claims is believed in order, and such action is earnestly solicited.

Respectfully submitted,

June 29, 2005

Wesley W. Whitmyer, Jr., Registration No. 33,558
Steven B. Simonis, Reg. No. 54,449
ST. ONGE STEWARD JOHNSTON & REENS
986 Bedford Street
Stamford, Connecticut 06905
(203) 324-6155
Attorneys for Appellant